# Solar Neutrino Analysis of the SNO Data

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The construction of the SNO detector has now been completed, and our group's focus has shifted from hardware design, construction and installation to preparing for neutrino physics data analysis.

The primary physics objective of the SNO experiment is to measure the solar neutrino flux with both charged current (CC) and neutral current (NC) reactions. Because of the SNO detector's unique capability of detecting neutrinos of all active flavors through the NC channel, we can test the neutrino oscillation hypothesis in a model independent way. The CC channel in the SNO detector is sensitve only to $\nu_e$. Hence, a NC–to–CC deviation from unity, after proper normalization to the cross section and the detector efficiency, is convincing evidence of neutrino oscillation. Data analysis centering around this NC/CC ratio measurement is the primary activity that our group is pursuing. Our group is also pursuing the CC spectral shape distortion and the CC to elastic scattering (ES) ratio analyses. These two measurements can also provide further evidence for neutrino oscillation.

In the past year we have been preparing for "day–one" of solar neutrino analysis. SNO is a complex experiment, and the solar neutrino analysis is very involved. Figure 1 shows a simple flow chart of how the neutrino physics can be extracted. The linear path on the left–hand side of the diagram shows the crucial components in extracting the solar neutrino flux, whereas all the supporting analyses to these different components are shown on the right–hand side of the diagram.

The supporting analyses can be roughly divided into two broad categories: calibration, and event reconstruction and recognition. Our group has an on–going effort to analyze the PLED and $^{16}$N calibration data taken during the commissioning of the SNO detector. The reader is referred to other complementary articles in this annual report for more details about these analysis activities.

We have been working on several different techniques in event reconstruction and recognition. Robust event fitters are being developed, and we have been using the SNO air–fill and partial–fill data to test out the robustness of these algorithms. We are also exploring the possibility of using neural network techniques in distinguishing real neutrino events from physical background (for example, $\beta$-$\gamma$'s from the detector construction material) and from unphysical background (for example, light emitted intermittently by the photomultiplier tubes — "flashers"). In order to understand the systematic involved in the different reconstruction and recognition techniques, we have an on–going program to accumulate Monte Carlo simulation data for all the physics and background classes. This simulation work is being done using the the Parallel Distributed Systems Facility (PDSF) maintained by the National Energy Research Scientific Computing Center (NERSC).
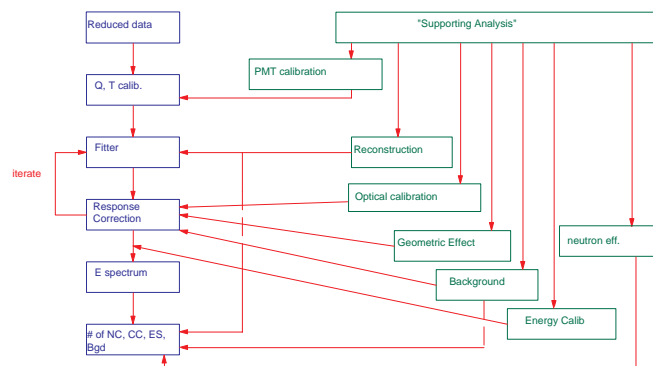


Figure 1: A simple analysis flow chart for SNO neutrino physics analysis.